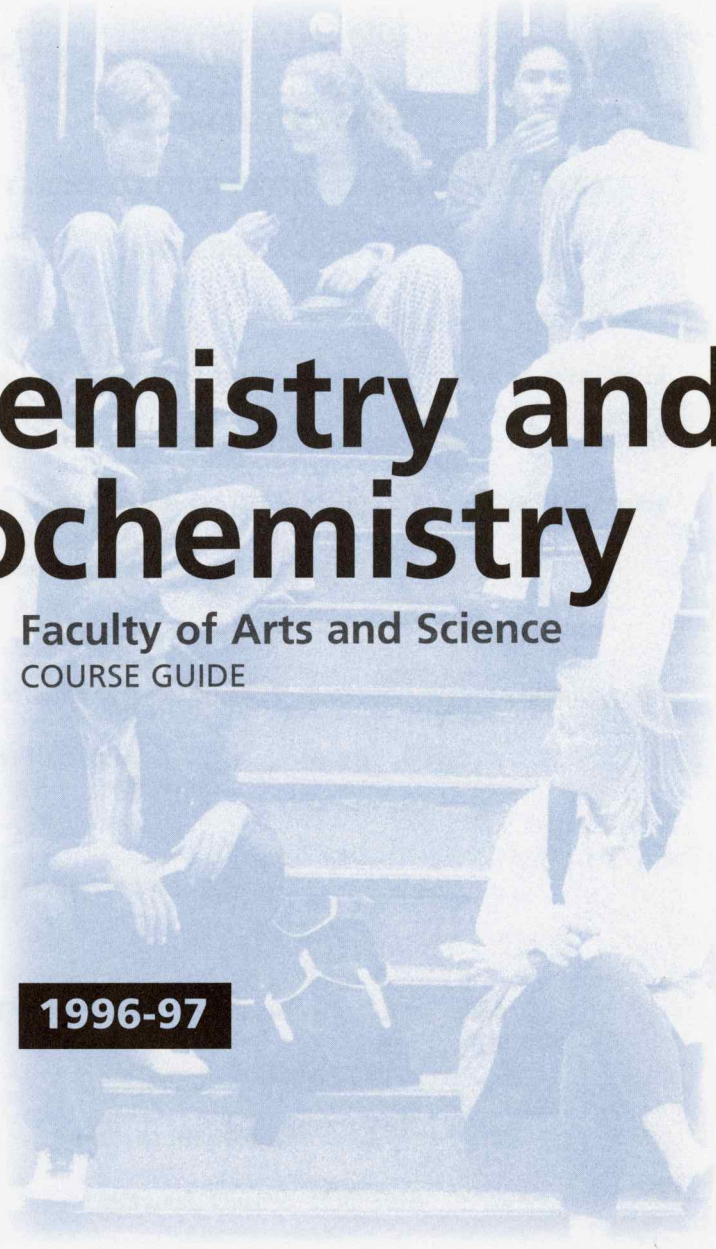


Chemistry and Biochemistry

Faculty of Arts and Science

COURSE GUIDE

1996-97

Concordia
UNIVERSITY

CONCORDIA UNIVERSITY

DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

COURSE GUIDE

This guidebook was prepared to give the prospective student an overview of the Department, the facilities and the programmes. **Some of the information in this booklet is subject to change. The Official University document is The Undergraduate Calendar.**

Students are advised not to purchase textbooks before consulting the professor at the first class.

Questions may be directed to:

The Department of Chemistry and Biochemistry

Sir George Williams Campus

1455 de Maisonneuve Blvd. West

Montreal, Quebec H3G 1M8

Tel: (514)848-3366

Table of Contents

The Science of Chemistry

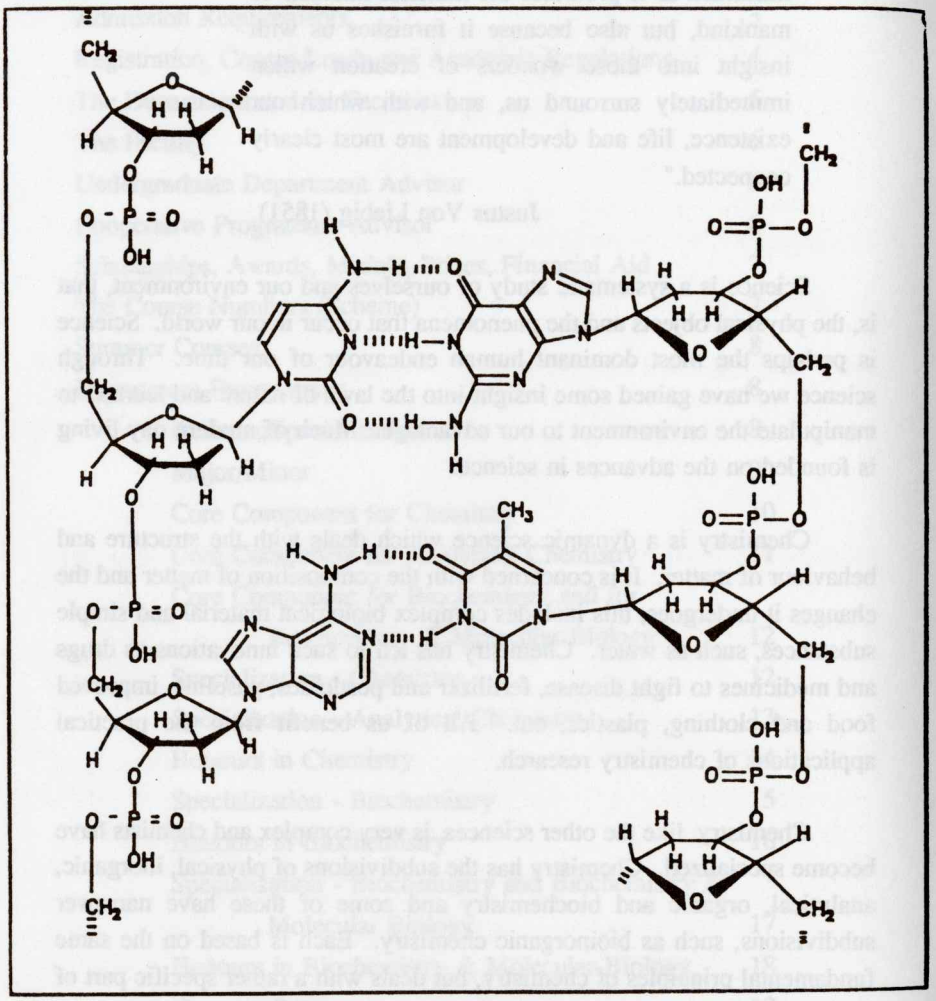
> "The study of chemistry is profitable, not only inasmuch as it promotes the material interests of mankind, but also because it furnishes us with insight into those wonders of creation which immediately surround us, and with which our existence, life and development are most clearly connected."
>
> Justus Von Liebig (1851)

Science is a systematic study of ourselves and our environment, that is, the physical objects and the phenomena that occur in our world. Science is perhaps the most dominant human endeavour of our time. Through science we have gained some insight into the laws of nature and learned to manipulate the environment to our advantage. Much of modern day living is founded on the advances in science.

Chemistry is a dynamic science which deals with the structure and behaviour of matter. It is concerned with the composition of matter and the changes it undergoes, this includes complex biological material and simple substances, such as water. Chemistry has led to such innovations as drugs and medicines to fight disease, fertilizer and pesticides, gasoline, improved food and clothing, plastics, etc. All of us benefit from the practical applications of chemistry research.

Chemistry, like the other sciences, is very complex and chemists have become specialized. Chemistry has the subdivisions of physical, inorganic, analytical, organic and biochemistry and some of these have narrower subdivisions, such as bioinorganic chemistry. Each is based on the same fundamental principles of chemistry, but deals with a rather specific part of chemistry. These divisions are all inter-dependent. Many of the important discoveries have been the result of team-work involving chemists from the various sub-divisions.

DNA : THE MOLECULE OF HEREDITY



The above is a simplified schematic partial structure of a nucleic acid called deoxyribonucleic acid (DNA), the molecule of heredity, which was elucidated through the co-operation of all branches of chemistry. Biochemists isolated the compound, analytical chemists learned its composition, organic chemists studied the structure of components and synthesized models of it. The physical chemists elucidated the overall

structure of this huge molecule, using physical methods like X-ray crystallography, and biochemists again studied its function in transmitting all hereditary properties of all living organisms from generation to generation. The importance of all this knowledge cannot be overestimated. The researcher, in close co-operation with colleagues continues to establish the intricate details of the correlation between structure and function.

OBJECTIVE OF THE DEPARTMENT

The Department's aim is to offer the best undergraduate education in chemistry or biochemistry whether it is for a student who is intending to be a specialist, or one who is taking courses in chemistry as a requirement of some other career or for general interest. The faculty and facilities of the department are chosen with this aim in mind. Students are encouraged to meet individually with faculty members.

ADMISSION REQUIREMENTS

Quebec students usually enter the first year of the 90-credit programme after completing the two year CEGEP programme. These students are expected to have completed the "Science Profile" as established through joint action of the Quebec universities and the provincial Department of Education. This profile includes the following courses: Mathematics 103, 203, Physics 101, 201, 301; Chemistry 101, 201 and Biology 301. Graduates of the three year CEGEP technical programme are also admissible.

Students from outside the province may also apply for admission. They may be admitted directly to the 90-credit programme or to an extended credit undergraduate programme depending upon the qualifications submitted. Consult the University Calendar for details.

Students who have not completed collegial studies and are over 21 years of age may apply for admission provided they meet the other criteria as a mature student. Students who wish to use the alternative entry

provisions should consult the "Mature Student Programme" in the University Calendar.

All students must make sure that they follow the requirements set out in their letter of admission.

More detail is available in Section 13 of the Undergraduate Calendar.

REGISTRATION, COURSE LOADS AND ACADEMIC REGULATIONS

Each student will receive a package of information regarding the Registration process, which includes the registration dates. Students must see a Department Advisor who will help in choosing the courses and planning their programme. Unless you are a returning student it is mandatory to have an advisor approve your courses before Registration. You must make an appointment with an advisor:

Telephone: 848-3355

Make sure you bring a copy of your academic record and your letter of admission when you meet the advisor.

The normal course load for a full-time student is 30 credits for the academic year. (Note: enrolling in less than 30 credits in an academic year will make a student ineligible for many scholarships, bursaries or loans). Only the Vice-Dean for Student Affairs of the Faculty of Arts and Science can approve a course overload (ie more than 30 credits) for a student. Please read the Undergraduate Calendar for deadlines (Section 11) and regulations (Section 16) regarding course changes, withdrawals etc. Make sure that you understand the Degree Requirements (Section 31.003) and Academic Performance Regulations (Section 31.003.01) for the Faculty of Arts and Science.

THE DEPARTMENT AND ITS FACILITIES

A list of the full-time faculty members in the department is shown on the opposite page. Although most courses are taught by full-time faculty, there is a variable number of adjunct professors and part-time lecturers. There are over 18 support staff, which includes technicians, secretaries, laboratory assistants etc. The faculty teach and do research in the major areas of chemistry and biochemistry.

The department's teaching and research laboratories are located at the Sir George Williams Campus.

Some of the major facilities include: The Canadian Centre for Picosecond Laser Spectroscopy, (this unit is for flash photolysis on the picosecond and nanosecond time scale); a laser spectroscopy laboratory; X-ray diffraction and nuclear magnetic resonance. Other units, such as the Laboratory for Inorganic Materials and The Science Industrial Research Unit are located within the department.

The department offers graduate programmes at the master and doctoral levels. Full details of these are found in the Graduate Faculty Calendar or through the department's Graduate Programme Director. The faculty is actively involved in research in Analytical Chemistry, Biochemistry, Inorganic Chemistry, Physical Chemistry and Organic Chemistry and directs master and doctoral students in their thesis work. Our undergraduate students have a first-hand opportunity to engage in a research project with a faculty member of their choice in their final year.

FACULTY

Chairman and Associate Professor

T.J. Adley

Professors

P.H. Bird
L.D. Colebrook
A. English
M.J. Kornblatt
N.Serpone
O.S. Tee

Assistant Professors

P.Banks
W. Findlay
D. Jack
J. Turnbull

Professor Emeritus

M. Doughty

Asssociate Professors

M.E. Baldwin
J.A. Capobianco
G. Dénès
Z. Hamlet
P. Joyce
M.F. Lawrence
R. Le Van Mao
S.R. Mikkelsen
R.H. Pallen
J. Powlowski
R.T. Rye
Y. Tsantrizos
R.A. Westbury
R.H. Zienius

UNDERGRADUATE DEPARTMENT ADVISOR

Ms. D. Gordon
Office: H-1139 (Hall Building) Telephone: 848-3355

Please note that unless you are a returning student in good standing it is mandatory to see the department advisor before registering for courses. It is advisable to make an appointment.

CHEMISTRY/BIOCHEMISTRY COOPERATIVE EDUCATION PROGRAMME DIRECTOR

Dr. R.H. Zienius
Office: H-1151 (Hall Building) Telephone: 848-3352

SCHOLARSHIP, AWARDS, MEDALS, PRIZES AND FINANCIAL AID

A number of scholarships and prizes are available to students in the Department. Some of these are awarded before starting the programme of study at Concordia, such as, Entrance Scholarships, while others are awarded during the course of studies, such as, In-Course Scholarships. There are also Federal and Provincial Loans and Bursaries for eligible candidates. Further information is available in Section 18.7 of the Undergraduate Calendar.

THE COURSE NUMBERS

Course numbers consist of three digits. The first digit is an indication of the level of the course. Two hundred level courses are normally taken during the first year and will have Chemistry 205 and 206 as prerequisites and possibly other 200 level courses. Three hundred level courses are normally taken during second year. These will have 200 level courses as prerequisites and possibly some at the 300 level. The 400 level courses are taken in the final year and will have 300 level courses as prerequisites. They may require some 400 level courses to be taken previously or concurrently.

Students are advised to note the prerequisites carefully when planning their programmes.

The second digit in the course number indicates a field of chemistry. A zero indicates a field of general interest, 1 designates analytical chemistry, 2 designates organic chemistry, 3 physical chemistry, 4 inorganic chemistry, 5 a research course, 7 biochemistry, 8 industrial or environment chemistry and 9 instrumentation.

The third number in the numbering sequence is used to designate the different courses within a field. For example the number 231 would indicate the first course in physical chemistry at the introductory level.

SUMMER COURSES

There is a limited number of courses offered in the summer session. Most are courses of the second semester of the second year, offered as part of the Chemistry/Biochemistry Coop programme schedule. Other students may enrol in these courses if there is space available.

DEPARTMENT PROGRAMMES

The Department offers a variety of programmes at different levels to suit the particular needs of the student. The different areas are Chemistry, Biochemistry and Analytical Chemistry. In addition there is a programme in Geology-Chemistry.

The different levels are the **Honours, Specialization, Major** and **Minor** programmes. Traditionally Canadian universities required an Honours degree to qualify for admission to a graduate programme. In the Quebec system the Specialization has replaced the Honours programme as the entrance requirement. The difference between the Honours programme and the Specialization programme is the higher performance level demanded in the Honours programme (See Undergraduate Calendar Section 31.003) and the inclusion of the Research Project and Thesis, which requires more independent work of the student and an oral defence of the thesis before the Department. The Specialization programme has the Independent Study and Practicum, which is also a research project with closer supervision, a written thesis and an oral defence before a committee.

Note: Students are responsible for satisfying their particular degree requirements. **All students are advised to include a course in a computer language in their degree programme.** The Order of Chemists of Québec has fully accredited the curricula of i) Honours in Chemistry; ii) Honours in Biochemistry; iii) Specialization in Analytical Chemistry; iv) Specialization in Biochemistry; v) Specialization in Chemistry. Upon satisfactory completion of any of the above-mentioned programmes, a graduate is eligible for membership in the Order. A working knowledge of French is required.

Please note that the BSc Specialization in Biochemistry and Molecular Biology does **not** meet the requirements of The Order of Chemists of Québec.

(The Quebec Order of Chemists regulates the practice of both chemists and biochemists in Quebec.)

Major/Minor

These programmes do not provide a sufficient depth in chemistry to pursue a career in chemistry. However, they may be combined with programmes in other disciplines where a knowledge of chemistry is useful for the student's chosen career. The major is essentially the core programme, whereas the minor is 24 credits chosen to form a coherent group of courses to complement the student's other areas of study.

Exemptions

A student may be exempted from one or more of the introductory courses, on the basis of work done at CEGEP level. Where exemptions are given, replacement courses must be chosen with the approval of a Department Advisor. In the case of certain programmes approved by the Order of Chemists of Quebec, the courses must be replaced with an equivalent number of credits in the same sub-discipline of the exemptions.

The course composition of these programmes is as follows:

(Note: A description of each course is given after the section on programmes.)

As previously noted a student must successfully complete 90 credits of course-work to fulfill the requirements for a B.Sc. The difference in credits between 90 and the programme requirements is made up from "elective" courses. In the Faculty of Arts and Science a student must successfully complete, at least, 24 credits outside of the discipline or department.

The following **"CORE COMPONENTS"** are an integral part of the programmes as noted in each case.

CORE COMPONENT FOR CHEMISTRY (45 credits)

	Credits
CHEM. 217 Analytical Chemistry I	3
CHEM. 218 Analytical Chemistry II	3
CHEM. 221*Organic Chemistry I	3
CHEM. 222*Organic Chemistry II	3
CHEM. 234 Physical Chemistry I	3
CHEM. 235 Physical Chemistry II	3
CHEM. 241 Inorganic Chemistry I	3
CHEM. 242 Inorganic Chemistry II	3
CHEM. 271 Biochemistry I	3
CHEM. 312 Analytical Chemistry III	3
CHEM. 324 Organic Chemistry III	3
CHEM. 325 Organic Chemistry IV	3
CHEM. 333 Physical Chemistry III	3
CHEM. 334 Physical Chemistry IV	3
CHEM. 341 Inorganic Chemistry III	3

*For students entering with the CEGEP equivalents, these credits must be replaced with an equivalent number of other Organic Chemistry credits.

CORE COMPONENT FOR ANALYTICAL CHEMISTRY
(45 CREDITS)

	Credits
CHEM 217 Analytical Chemistry I	3
CHEM 218 Analytical Chemistry II	3
CHEM 221* Organic Chemistry I	3
CHEM 222* Organic Chemistry II	3
CHEM 234 Physical Chemistry I	3
CHEM 235 Physical Chemistry II	3
CHEM 241 Inorganic Chemistry I	3
CHEM 242 Inorganic Chemistry II	3
CHEM 271 Biochemistry I	3
CHEM 312 Analytical Chemistry III	3
CHEM 324 Organic Chemistry III	3
CHEM 325 Organic Chemistry IV	3
CHEM 333 Physical Chemistry III	3
CHEM 334 Physical Chemistry IV	3
Plus 3 credits from either CHEM 341 or CHEM 375 (depending upon the option that is chosen.)	3

* For students entering with the CEGEP equivalents, these credits must be replaced with an equivalent number of other Organic Chemistry credits.

CORE COMPONENT FOR BIOCHEMISTRY AND FOR BIOCHEMISTRY AND MOLECULAR BIOLOGY (48 Credits)

		Credits
BIOL. 261	Molecular and General Genetics	3
BIOL. 266	Cell Biology	3
BIOL. 364	Cell Physiology	3
BIOL. 367	Molecular Biology	3
BIOL. 368	Genetics and Cell Biology Lab.	3
CHEM. 217	Analytical Chemistry I	3
CHEM. 218	Analytical Chemistry II	3
CHEM. 221*	Organic Chemistry I	3
CHEM. 222*	Organic Chemistry II	3
CHEM. 234	Physical Chemistry I	3
CHEM. 235	Physical Chemistry II	3
CHEM. 241	Inorganic Chemistry I	3
CHEM. 271	Biochemistry I	3
CHEM. 324	Organic Chemistry III	3
CHEM. 335	Biophysical Chemistry	3
CHEM. 375	Biochemistry II	3

*For students entering with the CEGEP equivalents, these credits must be replaced with an equivalent number of other Organic Chemistry credits.

SPECIALIZATION IN CHEMISTRY (60 Credits)

Core Component for Chemistry	**45**
MATH. 220 Mathematical Methods in Chemistry	3
CHEM. 419*Independent Study and Practicium	6
Additional credits in Chemistry ‡	6

*With departmental permission, the student may substitute CHEM. 450 for CHEM. 419.

‡It is recommended that these courses be at the 400 level.

SPECIALIZATION IN ANALYTICAL CHEMISTRY (60-63 Credits)

		Credits
Analytical Option		**(60)**
Core Component for Analytical Chemistry		**45**
CHEM 419*	Independent Study and Practicum	
	or, with permission	
CHEM 450*	Research Project and Thesis	6
and	9 Credits chosen from:	
CHEM 412	Statistical Methods in Chemistry	3
CHEM 413	Advanced Bioanalytical Chemistry	3
CHEM 493	Magnetic Resonance Spectroscopy	3
CHEM 494	Mass Spectrometry	3
CHEM 498G	Analytical Separations	3

Bioanalytical Option		**(63)**
Core Component for Analytical Chemistry		**45**
CHEM 419*	Independent Study and Practicum	
	or, with permission	
CHEM 450*	Research Project and Thesis	6
and	9 credits chosen from:	
CHEM 413	Advanced Bioanalytical Chemistry	3
CHEM 414	Advanced Bioanalytical Chemistry Laboratory	3
Biol 261	Molecular and General Genetics	3
and	3 credits chosen from:	
CHEM 412	Statistical Methods in Chemistry	3
CHEM 493	Magnetic Resonance Spectroscopy	3
CHEM 494	Mass Spectrometry	3
CHEM 498G	Analytical Separations	3

* These must be in Analytical Chemistry

HONOURS IN CHEMISTRY

An Honours in Chemistry programme consists of completion of the requirements of the Specialization in Chemistry, or the requirements of the Specialization in Analytical Chemistry, with the election of CHEM. 450 as the senior research project.

NOTE: Students must meet the University regulations concerning the Honours degree (see page 19 of the booklet and Section 31.003 of the Undergraduate Calendar). Honours students are encouraged to attend departmental seminars.

Honours in Chemistry (60 Credits)

	Credits
Core Component in Chemistry	**45**
MATH. 220 Mathematical Methods in Chemistry	3
CHEM. 450 Research Project and Thesis	6
Additional Credits in Chemistry‡	6

‡It is recommended that these courses be at the 400 level.

SPECIALIZATION IN BIOCHEMISTRY (69 Credits)

		Credits
Core Component for Biochemistry		**48**
CHEM. 477	Advanced Lab in Biochemistry	3
BIOL. 466	Advanced Lab in Molecular Biology	3
CHEM. 312	Analytical Chemistry III	3
CHEM. 325	Organic Chemistry IV	3
CHEM. 333	Physical Chemistry IV	3
and	6 Credits* chosen from:	
CHEM. 471	Enzyme Kinetics & Mechanism	3
CHEM. 472	Chemical Toxicology	3
CHEM. 473	Medicinal Chemistry I	3
CHEM. 474	Medicinal Chemistry II	3
CHEM. 478	Hormone Biochemistry	3
CHEM. 481	Bioinorganic Chemistry	3
CHEM. 498	When Appropriate	3

*Note: 3 Credits may be replaced by a 400-level course in Cell & Molecular Biology

BIOL. 420	Radiation Biology & Radiotracer Methodology	3
BIOL. 441	Plant Biochemistry	3
BIOL. 461	Advanced Genetics	3
BIOL. 462	Immunology	3
BIOL. 464	Advanced Cell Physiology	3
BIOL. 465	Biology Regulatory Mechanisms	3
BIOL. 468	Gene Structure	3
BIOL. 469	DNA Repair	3
BIOL. 470	Microbial Physiology	3
BIOL. 498	When Appropriate	3

HONOURS IN BIOCHEMISTRY (72 Credits)

		Credits
Core Component for Biochemistry		**48**
CHEM. 450	Research Project and Thesis	6
CHEM. 477	Advanced Lab in Biochemistry	3
or		
BIOL. 466	Advanced Lab in Molecular Biology	3
CHEM. 312	Analytical Chemistry III	3
CHEM. 325	Organic Chemistry IV	3
CHEM. 333	Physical Chemistry III	3
and	6 Credits* chosen from:	
CHEM. 471	Enzyme Kinetics & Mechanism	3
CHEM. 472	Chemical Toxicology	3
CHEM. 473	Medicinal Chemistry I	3
CHEM. 474	Medicinal Chemistry II	3
CHEM. 478	Hormone Biochemistry	3
CHEM. 481	Bioinorganic Chemistry	3
CHEM. 498	When Appropriate	3

*Note: 3 Credits may be replaced by a 400-level course in Cell & Molecular Biology

BIOL. 420	Radiation Biology & Radiotracer Methodology	3
BIOL. 441	Plant Biochemistry	3
BIOL. 461	Advanced Genetics	3
BIOL. 462	Immunology	3
BIOL. 464	Advanced Cell Physiology	3
BIOL. 465	Biology Regulatory Mechanisms	3
BIOL. 468	Gene Structure	3
BIOL. 469	DNA Repair	3
BIOL. 470	Microbial Physiology	3
BIOL. 498	When Appropriate	3

NOTE: Students must meet the University regulations concerning the Honours degree (see page 19 of this booklet and Section 31.003 of the University Calendar). Honours students in second year and beyond are encouraged to attend departmental seminars.

SPECIALIZATION IN BIOCHEMISTRY AND MOLECULAR BIOLOGY (66 Credits)

		Credits
Core Component for Biochemistry		**48**
CHEM. 477	Advanced Lab in Biochemistry	3
BIOL. 466	Advanced Lab in Molecular Biology	3

and 12 Credits chosen from the following (at least 3 credits from each group):

CHEM. 471	Enzyme Kinetics & Mechanism	3
CHEM. 472	Chemical Toxicology	3
CHEM. 473	Medicinal Chemistry I	3
CHEM. 474	Medicinal Chemistry II	3
CHEM. 478	Hormone Biochemistry	3
CHEM. 481	Bioinorganic Chemistry	3
CHEM. 498	When Appropriate	3
BIOL. 420	Radiation Biology & Radiotracer Methodology	3
BIOL. 441	Plant Biochemistry	3
BIOL. 461	Advanced Genetics	3
BIOL. 462	Immunology	3
BIOL. 464	Advanced Cell Physiology	3
BIOL. 465	Biology Regulatory Mechanisms	3
BIOL. 468	Gene Structure	3
BIOL. 469	DNA Repair	3
BIOL. 470	Microbial Physiology	3
BIOL. 498	When Appropriate	3

HONOURS IN BIOCHEMISTRY AND MOLECULAR BIOLOGY (72 Credits)

		Credits
Core Component for Biochemistry and Molecular Biology		**48**
CHEM. 477	Advanced Lab in Biochemistry	3
BIOL. 466	Advanced Lab in Molecular Biology	3
CHEM. 450	Research Project and Thesis	6

and 12 Credits chosen from the following (at least 3 credits from each group):

CHEM. 471	Enzyme Kinetics & Mechanism	3
CHEM. 472	Chemical Toxicology	3
CHEM. 473	Medicinal Chemistry I	3
CHEM. 474	Medicinal Chemistry II	3
CHEM. 478	Hormone Biochemistry	3
CHEM. 481	Bioinorganic Chemistry	3
CHEM. 498	When Appropriate	3
BIOL. 420	Radiation Biology & Radiotracer Methodology	3
BIOL. 441	Plant Biochemistry	3
BIOL. 461	Advanced Genetics	3
BIOL. 462	Immunology	3
BIOL. 464	Advanced Cell Physiology	3
BIOL. 465	Biology Regulatory Mechanisms	3
BIOL. 468	Gene Structure	3
BIOL. 469	DNA Repair	3
BIOL. 470	Microbial Physiology	3
BIOL. 498	When Appropriate	

NOTE: Students must meet the University regulations concerning the Honours degree (see page 19 and Section 31.003 of the Undergraduate Calendar). Honours students are encouraged to attend departmental seminars.

HONOURS PROGRAMMES

To enter an Honours programme, students must apply to the Department Honours Advisor, after they have completed 30 credits at Concordia, (but not requiring fewer than 30 credits to graduate). To enter and remain in the Honours programme, a student must maintain an average of "B" in all courses of the Honours component of the programme. The minimum acceptable grade in any one of these courses is "C". A minimum average of "B-" must be maintained in each academic year.

For courses outside of the Honours component a student must have an average of no less than "C"; the minimum acceptable grade in these courses is "D".

See Section 31.003 of the Undergraduate Calendar.

MAJOR IN CHEMISTRY (45 Credits)

This programme is composed of the courses described in the Core Component. With prior approval of the Department Advisor, courses in related fields may be used as substitutions up to a maximum of 9 credits.

MAJOR IN BIOCHEMISTRY (45 Credits)

		Credits
BIOL. 261	Molecular and General Genetics	3
BIOL. 266	Cell Biology	3
BIOL. 364	Cell Physiology	3
BIOL. 368	Genetics & Cell Biology Lab	3
CHEM. 217	Analytical Chemistry I	3
CHEM. 218	Analytical Chemistry II	3
CHEM. 221*	Organic Chemistry I	3
CHEM. 222*	Organic Chemistry II	3
CHEM. 234	Physical Chemistry I	3
CHEM. 235	Physical Chemistry II	3
CHEM. 241	Inorganic Chemistry I	3
CHEM. 271	Biochemistry I	3
CHEM. 324	Organic Chemistry III	3
CHEM. 335	Biophysical Chemistry	3
CHEM. 375	Biochemistry II	3

*For students entering with the CEGEP equivalents, these credits must be replaced with an equivalent number of other Organic Chemistry credits.

MINOR IN CHEMISTRY (24 Credits)

This programme consists of courses chosen from the Department's offerings that form a coherent pattern to complement the student's other areas of interest. The courses chosen must have prior approval by a Department programme advisor.

SPECIALIZATION IN GEOLOGY-CHEMISTRY (78 Credits)

This is a joint specialization consisting of courses offered by both departments. This programme is described in the Undergraduate Calendar, see Geology Department, Section 31.140.

(Note: graduates from this programme are not eligible for membership in the Order of Chemists of Quebec).

COOPERATIVE EDUCATION PROGRAMME

The "Coop" Programme in Chemistry/Biochemistry has the same academic course requirements as the Honours or Specialization programmes taken by "regular stream" undergraduates. However, Coop students alternate their academic semesters with off-campus paid work terms in government or industrial laboratories where they are employed as chemists/biochemists in-training. Students who are above average academically, and interested in the Coop Programme should refer to the announcement in the Undergraduate Calendar, Section 31.515. More specific information may be obtained from the Director of the Chemistry/Biochemistry Coop Programme, Dr. Raymond H. Zienius (Telephone: 848-3352), or from the Institute for Cooperative Education (Telephone: 848-3950).

SCIENCE COLLEGE

Students planning to register in one of the programmes of the Department might consider joining the Science College. In the Science College students will gain an understanding of several areas of science while specializing in one that they choose. It is an opportunity to become acquainted with science as practiced and understood by scientists today. The goals of the Science College are to provide an opportunity for experience in a research environment, for thinking about the nature of science, and for becoming aware of the style and content of the various scientific disciplines. Students planning to register in a Specialization or a Major in the Department of Chemistry and Biochemistry are eligible for admission to Science College provided they meet the other entrance requirements of the College. See Section 31.550 of the Undergraduate Calendar or telephone 848-2595.

COURSE DESCRIPTIONS

Note: This list of courses does not imply that all of these courses will be offered in any particular year. Students must refer to the current schedule of courses for this information.

This section contains general descriptions of course contents. The names of the instructors are those that have taught the course recently and there may be changes, depending upon scheduling and work-loads. No text books are listed. Students are cautioned against buying textbooks, references, etc. without the advice of the instructor at the first class.

Courses that consist of both laboratories and lectures require that a satisfactory performance be obtained in each of the components for successful completion of the course.

Chemistry 205 General Chemistry I 3 credits

Instructors: P.H. Bird, R.H. Pallen, G. Dénès, B. Pant
Prerequisites: none
For: Mature Students and students who have not taken CEGEP level chemistry, students who wish to obtain some knowledge of chemistry or to continue in chemistry. This course, together with Chem. 206, is a prerequisite for all other courses in chemistry except Chem. 208.
Format: Lectures and laboratories, (Labs and tutorials alternate each week)
Basis of Grading: Combination of tests, lab. work and final exam.
Description: This course is intended to provide students with a knowledge of basic concepts in chemistry. Among the topics discussed are stoichiometry; states of matter, atomic and molecular structure, the periodic table and periodicity and chemical bonding.

Note: Students in programmes leading to the B.Sc. degree may not take this course for credit to be applied to their programme of concentration.

Chemistry 206 General Chemistry II 3 credits

Instructors: R.H. Pallen, N. Serpone
Prerequisites: Chemistry 205
For: Same as Chemistry 205
Format: Lectures and laboratories, (labs and tutorials alternate each week).
Basis of Grading: Combination of tests, lab. work and final exam.
Description: Thermochemistry, solutions and their properties, equilibrium, ionic equilibria, pH, buffers, kinetics, reaction mechanisms, other selected topics related to biochemistry, biology, and engineering.

Note: Students in programmes leading to the B.Sc. degree may not take this course for credit to be applied to their programme of concentration.

Chemistry 208 Chemical Hazards in the Work Environment 3 Cr.

Instructor: B. Pant
Prerequisites: none
For: Students not registered for a B.Sc.
Format: Lectures
Basic of Grading: Term paper, mid-term and final exams.
Description: An introduction to chemistry, chemical hazards and the social history of chemistry. Toxicity, combustion, corrosion, explosives, radiation and water reactive materials in the work environment are studied. An aim of the course is to help the student establish the chemical vocabulary and concepts necessary to understand the social impact of chemistry in relation to occupational health and safety. No previous knowledge of chemistry is assumed since the necessary quantitative and qualitative knowledge is developed throughout the course.

Note: This course may not be taken for credit by science students.

Chemistry 212 Analytical Chemistry for Biologists (3 credits)

Instructor: P. Banks
Prerequisites: CEGEP Chemistry 201; CEGEP Physics 301; CEGEP Math 203; or equivalent courses.
For: Degree programme in biology.
Format: Lectures and laboratory.
Basis of Grading: Class tests, final exam, lab work
Description: Chemical equilibria and titrations, treatment of analytical data, introduction to spectroscopy.

Note: This course may not be taken for credit by students registered in a Chemistry or Biochemistry programme.

Chemistry 217 Introductory Analytical Chemistry I 3 credits

Instructors: A. English, S. Mikkelsen, R.H. Zienius
Prerequisites: CEGEP Chem 201, Phys. 301, Math 102, 203 or equiv.
For: Degree programmes in chemistry, biochemistry, and analytical chemistry.
Format: Lectures and laboratory.
Basis of Grading: Class tests, final exam, lab work
Description: An introduction to the basic theories involved in analytical chemistry, as demonstrated by acid/base, complexations and solubility product equilibria. The laboratory gives practice in the classical methods of gravimetric and volumetric methods of analysis, which are fundamental procedures used to obtain the most accurate results in modern analytical chemistry.

Note: Students who have received credit for CHEM. 211 or GEOL. 324 may not take this course for credit.

Chemistry 218 Introductory Analytical Chemistry II 3 Credits

Instructors: A. English, S. Mikkelsen, R.H. Zienius
Prerequisites: Chem. 217
For: Degree programmes in chemistry, biochemistry and analytical chemistry.
Format: Lectures and laboratory.
Basis of Grading: Class tests, final exam, lab work
Description: A continuation of the study of basic theories of analytical chemistry as applied to precipitation titration and redox equilibria. This is followed by an introduction to the more commonly used instrumental analytical techniques, including: potentiometry and molecular, atomic and fluorescence spectroscopy. The laboratory provides practice in the use of basic instrumentation.

Note: Students who have received credit for CHEM. 211 or GEOL. 324 may not take this course for credit.

Chemistry 221 Introductory Organic Chemistry I 3 Credits

Instructors: T.J. Adley, L.D. Colebrook, M. Doughty
Prerequisites: Chemistry 206 or equivalent
For: All programmes in chemistry, biochemistry, biology and analytical chemistry.
Format: Lectures and laboratory.
Basis of Grading: Midterm and final exams, laboratory work.
Description: Basic aspects of orbitals and their role in covalent bonding. Acids and bases. Delocalization of electrons. Alkanes, their structures, isomerism and nomenclature. Introductory stereochemistry. Enantiomers, diastereomers, conformers, Fischer projections, Cahn-Ingold-Prelog sequence rules for specification of chirality. E/Z-isomerism. Conformations of cyclic compounds. Alkyl halides, S_N1, S_N2, E1, E2 reactions, their mechanisms and stereochemistry. Free-radical reactions, organometallic compounds. Chemistry of alcohols, ethers and related compounds.

Chemistry 222 Introductory Organic Chemistry II 3 credits

Instructors: T.J. Adley, M.E. Baldwin, M. Doughty, Z. Hamlet
Prerequisites: Chem. 221 or equivalent
For: All degree programmes in chemistry, biochemistry, biology and analytical chemistry.
Format: Lectures and laboratory.
Basis of Grading: Laboratory work, midterm and final exams.
Description: Introduction to the use of IR and NMR spectroscopy for identification of simple organic compounds. Chemistry of alkenes, alkynes and dienes. Electrophilic additions, Markovnikov's rule, conjugate additions, Diels-Alder reaction, polymerization. Benzenes, Huckel rule and aromaticity. Electrophilic aromatic substitution, its mechanism and orientation. Chemistry of aldehydes and ketones. Reduction, Wittig, and Grignard reactions. Aldol condensation. Chemistry of carboxylic acids and their derivatives. Chemistry of amines. Simple reaction mechanisms.

Chemistry 234 Physical Chemistry I Thermodynamics 3 credits

Instructors: M.F. Lawrence, R. Le Van Mao, R.T. Rye, R.A. Westbury
Prerequisites: CEGEP Chem. 201, Phys. 301, Math. 103, 203 or equiv.
For: Degree programmes in chemistry, biochemistry, and analytical chemistry.
Format: Lectures, Problem Assignments, and Assigned Readings.
Basis of Grading: Midterm and final exams
Description: The properties of real gases; fugacities; first, second and third laws of thermodynamics; the Phase Rule, one- and two-component systems; real solutions, and partial molal properties.

Note: Students who have received credit for CHEM. 231 or 232 or 332 or this topic under a CHEM. 298 number may not take this course for credit.

Chemistry 235 Physical Chemistry II Kinetics of Chemical Reactions
3 credits

Instructors: R. Le Van Mao, R.T. Rye
Prerequisite: Chem. 234
For: Degree programmes in chemistry, biochemistry, and analytical chemistry.
Format: Lectures and Laboratory.
Basis of Grading: Midterm and final exams
Description: Mathematical treatment of experimental results; theories of reaction rates; unimolecular reactions; the steady-state approximation; factors influencing rates of reactions in solution; acid-base catalysis, catalysis by enzymes and the Michaelis-Menten mechanism; free-radical reactions; photochemical reactions; experimental methods and techniques.

Note: Students who have received credit for CHEM. 331 or for this topic under a CHEM. 298 number may not take this course for credit.

Chemistry 241 Inorganic Chemistry I : Introduction to Periodicity and Valence Theory 3 credits

Instructors: J.A. Capobianco, N. Serpone
Prerequisites: CEGEP Chem. 201, Phys. 301, Math 103, 203 or equiv.
For: Degree programmes in chemistry, biochemistry, and analytical chemistry.
Format: Lectures, problem sessions and laboratory
Basis of Grading: Assignments, mid-term and final exams
Description: The structure of the atom, and its use in explaining the periodic table and properties of atoms; covalent bonding treatments - including Lewis Theory; the Valence Shell Electron Pair Repulsion Theory of structure, the valence bond and the molecular orbital theories of bonding. Crystal Field Theory applied to the structure and properties of transition metal complexes. Bonding theories of metallic materials and semi-conductors.

Chemistry 242 Inorganic Chemistry II. Chemistry of the Main Group Elements 3 credits

Instructors: G. Dénès
Prerequisites: CEGEP Chem. 201, Phys. 301, Math 103, 203 or equiv.
For: Degree programmes in chemistry and analytical chemistry
Format: Lectures and laboratory
Basis of Grading: Assignments, mid-term and final exams
Description: A survey of the properties and reactions of: Hydrogen, Group I (IA) (Lithium to Cesium) and Group 2 (IIA) (Beryllium to Radium), Group 11 (IB) (Copper to Gold), Group 12 (IIB) (Zinc to Mercury), Group 13 (IIIA) (Boron to Thallium), Group 14 (IVA) (Carbon to Lead), Group 15 (VA) (Nitrogen to Bismuth), Group 16 (VIA) (Oxygen to Tellurium), Group 17 (VIIA) (Fluorine to Astatine), Group 18 (VIII A) (Helium to Radon).

Chemistry 271 Introductory Biochemistry 3 credits

Instructors: P. Joyce, M.J. Kornblatt, J. Powlowski, J. Turnbull
Prerequisite: Chem. 222
For: Degree programmes in chemistry, biochemistry and analytical chemistry
Format: Lectures and tutorials
Description: This course is an introduction to the essentials of biochemistry. Topics discussed are protein structure, enzymology, carbohydrate metabolism electron transport integration and regulation of metabolism.
Note: Students who have received credit for CHEM. 371 or CHEM. 372 or CHEM. 373 may not take this course for credit.

Chemistry 312 Intermediate Analytical Chemistry 3 credits

Instructors: R.H. Zienius, S.R. Mikkelsen

Prerequisite: Chem. 218

For: Degree programmes in chemistry, biochemistry, and analytical chemistry

Format: Lectures and laboratory

Basis of Grading: Mid-term and final exams, laboratory work

Description: This course is a continuation of Chem. 218 with emphasis on instrumental analysis. Techniques discussed include emission spectroscopy; X-ray spectroscopy; voltammetry and polarography, amperometric titrations; coulometry and coulometric titrations; conductometry; chromatography with particular emphasis on gas chromatography and high performance liquid chromatography. Laboratory work is done concurrently and provides experience in the techniques discussed in lectures.

Note: Students who have received credit for any of CHEM.310, CHEM. 314, CHEM. 315 or CHEM. 319, may not take this course for credit.

Chemistry 324 Organic Chemistry III : Organic Reactions 3 cr.

Instructors: M.E. Baldwin, Z. Hamlet

Prerequisite: Chem. 222 or equivalent, Chem. 331 or Chem. 235 previously or concurrently.

For: Degree programmes in chemistry, biochemistry, and analytical chemistry

Format: Lectures and laboratory

Basis of Grading: Mid-term and final exams, laboratory work.

Description: This course is a mechanistic survey of reactions of major synthetic utility. It deals with reaction mechanisms and the importance of reactive intermediates such as carbocations, carbanions, radicals and carbenes.

Note: Students who have received credit for CHEM. 322 may not take this course for credit.

Chemistry 325 Organic Chemistry IV : Organic Structure and Stereochemistry 3 credits

Instructors: T.J. Adley, L.D. Colebrook, Z. Hamlet

Prerequisites: Chem. 222 or equivalent,, Chem. 331 or Chem. 235 previously or concurrently

For: Degree programmes in chemistry, biochemistry, and analytical chemistry

Format: Lectures and laboratory

Basis for Grading: Mid-term and final exams, laboratory work.

Description: The course examines organic structure and stereochemistry including the relationship of stereochemistry to physical properties and chemical reactivity. The use of chemical and spectroscopic means to determine structure and stereochemistry is included. The laboratory work involves the identification of organic compounds.

Note: Students who have received credit for CHEM. 321 may not take this course for credit.

Chemistry 326 Natural Products 3 credits

Instructors: L.D. Colebrook, Y.S. Tsantrizos

Prerequisite: Chem. 324 previously or concurrently

For: Optional course

Format: Lectures

Basis of Grading: Mid-term and final exams

Description: The structures, mechanisms of action and biosynthetic origins of biologically important compounds such as fatty acids, polyketides, steroids, alkaloids and beta- lactam antibiotics are discussed. The role of traditional organic chemistry in the development of modern biochemistry and biotechnology is illustrated with examples from medicine and agriculture.

Note: Students who have received credit for Chem. 398A may not take this course for credit.

Chemistry 327 Organic Chemistry of Polymers 3 credits

Instructor: R.H. Pallen
Prerequisites: Chem. 222 or equivalent
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Introduction to the fundamental aspects of polymers and polymerization. Methods of preparation, reaction mechanisms of polymer synthesis. Includes the various types of mechanism: condensation, free radical, anionic, cationic and Ziegler-Natta or heterogeneous polymerizations.

Chemistry 328 Analytical Organic Chemistry and Spectroscopy
3 credits
Instructor: T.J. Adley
Prerequisites: Chem. 217, 218, 222 and 333
For: Optional
Format: Lectures and laboratory
Basis of Grading: Mid-term, final exams and laboratory work
Description: Principles of physical, chemical and instrumental methods of identification and analysis of organic compounds. 'Wet' chemistry as a means of functional group identification. Protocol of identification of unknown organic compounds by chemical and spectroscopic methods. Application of vibrational, electronic, nuclear magnetic resonance and mass spectrometric techniques in the elucidation of structure of organic compounds.

Note: Students who have received credit for CHEM. 311 and CHEM. 316, or CHEM. 391 may not take this course for credit.

Chemistry 333 Physical Chemistry : Spectroscopy and Quantum Theory 3 credits

Instructors: D. Jack, M.F. Lawrence, D. Sharma
Prerequisites: CHEM. 235
For: Degree programmes in chem., biochem., and analytical chem.
Format: Lectures
Basis of Grading: Mid-term, final exams and assignments
Descriptions: The course introduces students to the ideas of quantum mechanics, spectroscopy, and the electronic structure of atoms and molecules. Topics include the origins and postulates of quantum theory; applications to simple systems; the hydrogen atom; the aufbau principle of the elements; simple molecules. Spectroscopy and spectroscopic measurement; simple atomic spectra; infrared and Raman spectra of simple molecules; fluorescence; N.M.R.

Note: Students who have received credit for CHEM. 233 may not take this course for credit.

Chemistry 334 Physical Chemistry: Laboratory 3 Credits

Instructor: R.T. Rye
Prerequisites: CHEM. 235
For: Degree programmes chemistry and analytical chemistry.
Format: Laboratory
Basis of Grading: Laboratory work and reports.
Descriptions: A series of experiments illustrating modern techniques for the examination of solids, liquids, and gases. Some experiments may include the automated collection and computerized analysis of data.

Note: Students who have received credit for CHEM. 338 and 339 may not take this course for credit.

Chemistry 335 Biophysical Chemistry 3 Credits

Instructor: W. Findlay, R.T. Rye
Prerequisites: CHEM. 235, CHEM. 271
For: Degree programmes in biochemistry and biochemistry and molecular biology.
Format: Lectures and laboratory.
Basis of Grading: Mid-term, final exams and laboratory work
Description: Physical techniques used to study the structure of biological macromolecules.

Chemistry 341 Inorganic Chemistry III : The Transition Elements
3 credits

Instructors: P.H. Bird, J.A. Capobianco, G. Dénès, N. Serpone
Prerequisites: Chem. 217, 218, 241, 242
For: Degree programmes in chemistry and analytical chemistry
Format: Lectures and laboratory
Basis of Grading: Mid-Term, final exam and laboratory work
Description: Theories of bonding in transition metal complexes, including ligand field theory, applied to structure, physical properties, and reactivity of transition metal complexes: organometallic chemistry and catalysis. Metals in biological systems. Lectures and laboratory.

Note: Students who have received credit for CHEM. 342 or CHEM. 348 may not take this course for credit.

Chemistry 375 Biochemistry II 3 credits

Instructors: M.J. Kornblatt, J. Powlowski, J. Turnbull
Prerequisite: Chem. 271
For: Specialization biochemistry
Format: Lectures and laboratory
Basis of Grading: Mid-term and final exams, lab. work and reports.
Description: This course surveys selected pathways in intermediary metabolism including their regulation and physiological significance; the urea cycle; fatty acid oxidation; biosynthesis of nucleosides, tetrapyrroles, carotenoids, cholesterol and steroidal hormones. The biosynthesis of vitamins and cofactors and the metabolism of selected aminoacids may also be discussed.

Note: Students who have received credit for Chem. 371 or 372 or 373 may not take this course for credit.

Chemistry 398 Selected Topics in Chemistry 3 credits

Courses under this number and heading are scheduled as the demand and opportunity arises. There is no guarantee that a particular topic will be scheduled in any particular year. Students are advised to consult the schedule.

Topics that have been offered in the past few years are noted below:

Chem. 398A Natural Products (See Chem. 326)	3 credits
Chem. 398B Bioorganic Chemistry	3 credits

Chemistry 412 Statistical Methods in Chemistry 3 credits

Instructor: R.A. Westbury
Prerequisite: Chem. 218
For: Optional course
Format: Lectures
Basis of Grading: Assignments, mid-term and final exam
Description: A study of some of the methods used by chemists to analyze data, systematically collate data, and plan the efficient collection of further data. As much as possible, the class discussions will draw upon chemical examples, but there will not be a heavy emphasis on theoretical proofs. Use of the University's computers is encouraged for doing assignments.

Note: Students who have received credit for Chem. 498Z may not take this course for credit.

Chemistry 419 Independent Study and Practicum 6 credits

Instructor: The faculty
Prerequisites: A grade of C (grade point average of 2.00) in 31 credits of the core programme courses, acceptance by a supervisor, confirmation by the Coordinator of Senior Thesis (Dr. R.H. Zienius). This must be done before registering in the course.
For: All Specialization programmes (except biochemistry)
Format: Laboratory and conferences
Basis of Grading: Written report of laboratory work and oral examination by a committe of Department members.
Description: In collaboration with and under the direction of a faculty member, the student carries out independent study and practical work on a problem chosen from the student's area of concentration.

Chemistry 421 Physical Organic Chemistry 3 credits

Instructor: O.S. Tee
Prerequisites: Chem. 325, 331 or Chem. 235
For: Optional course
Format: Lectures
Basis of Grading: Assignments and final exam
Description: Determination of organic reaction mechanisms using kinetics, activation parameters, acid-base catalysis, Bronsted catalysis law, solvent effects, medium effects, isotope effects, substitutent effects and linear free energy relationships.

Chemistry 423 Heterocylic Chemistry 3 credits

Instructor: O.S. Tee
Prerequisites: Chem. 325
For: Optional course
Format: Lectures
Basis of Grading: Assignments, final exam
Description: Survey of the chemistry of 3-,4-,5-, and 6- membered heterocycles, with a particular emphasis on heteroaromatic systems. Synthesis and reactions of heterocycles; their use in synthesis; factors affecting their reactivity.

Note: Students who have received credit for this topic as CHEM. 498 may not take this course for credit.

Chemistry 424 Organic Synthesis **3 credits**

Instructor: Y.S. Tsantrizos
Prerequisite: Chem 324
For: Optional course
Format: Lectures
Basis of Grading: mid-term and final exams
Description: This course is concerned with synthetic strategy and design. Applications of modern synthetic methods and reagents are exemplified by synthesis of natural products, peptides, nucleic acids, and novel chemotherapeutic agents.

Note: Students who have received credit for CHEM 422 may not take this course for credit.

Chemistry 441 Single Crystal X-Ray Diffraction 3 credits

Instructor: P.H. Bird
Prerequisites: Chem. 325
For: Optional course
Format: Lectures
Basis of Grading: Assignments and final exam.
Description: Space group symmetry, diffraction of X-rays by single crystals, photographic and counter methods of diffraction data collection. Solution and refinement of crystal structures. Interpretation of atomic coordinates and vibrations.

Note: Students who have received credit for Chem. 498I may not take this course for credit.

Chemistry 442 Physical Methods in Inorganic Chemistry 3 credits

Instructor: P.H. Bird
Prerequisites: Chem. 328, 341
For: Optional course
Format: Lectures
Basis of Grading: Assignments
Description: Introduction to symmetry and the character tables. Diffraction methods, X-ray, ESCA, UV-Visible, ORD and CD, EPR, Mössbauer, NQR, NMR, IR, and Raman.

Chemistry 444 Mössbauer Spectroscopy and Magnetic Properties of Materials 3 credits

Instructor: G. Dénès
Prerequisites: Chem. 241, 242, and 341 previously or concurrently
For: Optional course
Format: Lectures
Basis of Grading: Class tests, assignments, final exam.
Description: Introduction to the crystalline state, X-ray and neutron diffraction. Vibrational properties of solids, phonons. Magnetic properties of materials: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism and other ordered states. Theory of the Mössbauer effect, hyperfine interactions. Examples of Mössbauer studies: iron, tin, other main group elements, other transition elements, lanthanides and actinides. Combined studies of solids by X-ray and neutron diffractions, magnetic measurments and Mössbauer spectroscopy.
Note: Students who have received credit for CHEM. 498M may not take this course for credit.

Chemistry 445 Heterogeneous Catalysis 3 credits

Instructor: R. Le Van Mao
Prerequisite: Chem. 231 or Chem. 234
For: Optional course
Format: Lectures
Basis of Grading: Mid-term, final exam and assignments.
Description: Surface phenomena in heterogeneous catalysis (adsorption; texture of solids; introduction to the main techniques for the characterization of catalysts). Relationships between surface properties and catalyst activities (basic concepts in Catalysis). Catalytic kinetics. Catalytic reaction systems (introduction to the theory of catalytic reactors; diffusion, heat and mass transfer within porous solids; shape selectivity; catalyst activity decay). Industrial Catalysis : new trends.
Note: Students who have received credit for CHEM. 498N may not take this course for credit.

Chemistry 447 Electronic Spectroscopy 3 credits

Instructor: J.A. Capobianco
Prerequisites: Chem. 233 or Chem. 333, 341
For: Optional course
Format: Lectures
Basis of Grading: Paper, oral presentation of paper, final exam.
Description: This course is intended to provide the student with the theoretical background necessary to understand and work with electronic spectra, to illustrate and discuss the methods involved in assigning spectral transitions, and to explain the spectra which have been found for the transition metal ions in various oxidation states and symmetries.

This course assumes that the students has some knowledge of atomic structure, molecular symmetry and group theory.

Note: Students who have received credit for CHEM. 498R may not take this course for credit.

Chemistry 449 Laboratory in Synthesis and Techniques in Inorganic Chemistry 1 credit

Instructor: P.H. Bird
Prerequisite: Chem. 442 previously or concurrently
For: Optional course
Format: Laboratory
Basis of Grading: Laboratory work and reports
Description: Some of the techniques discussed in Chem. 442 will be employed in the laboratory to characterize and determine properties of compounds synthesized in the laboratory.

Chemistry 450 Research Project and Thesis 6 credits

Instructor: The faculty
Prerequisite: Third year standing in Honours Chemistry (Completed 60 credits), or permission of the Department (provided the student has a grade point average of 3.00 (B) or better, for all Core Programme Courses).
For: Honours programmes or students with permission
Format: Laboratory and conferences
Basis of Grading: Written thesis and oral defence of work before the faculty.
Description: The student works on a research project, in the student's area of concentration, selected in consultation with and conducted under the supervision of a faculty member of the Department; and writes a thesis on the results. The project is also the subject of a seminar before the Department.

Note: Students planning to take this course must consult with the Coordinator of Senior Theses, (Dr. R.H. Zienius) as early as possible the year before the final year.

Chemistry 471 Enzyme Kinetics and Mechanism 3 credits

Instructor: J. Turnbull
Prerequisites: Chem. 271; 60 credits in Chemistry
For: Optional course in biochemistry programmes
Format: Lectures
Basis of Grading: Mid-term, final exams, and assignments. (No supplementals allowed in this course.)
Description: Steady state kinetics, including the use of initial velocity studies and product inhibition to establish a kinetic mechanism; non-steady-state kinetics, isotope effects, energy of activation, etc; detailed mechanisms of selected enzymes.

Chemistry 472 Chemical Toxicology 3 credits

Instructor: M.E. Baldwin
Prerequisites: Chem. 271 and 3rd year standing or Department permission.
For: Optional course
Format: Lectures
Basis of Grading: Assignments, final exam
Description: Introduction to the general principles of toxicology with emphasis on the toxic effects of chemicals in humans. Dose-response relationship, types and routes of exposure, absorption and disposition of toxic substances, toxicokinetics, types of toxic response and factors affecting toxic response. Toxicity testing, risk assessment and interpretation of toxicological data.

Note: Students who have received credit for Chem. 498V may not take this course for credit.

Medicinal Chemistry (formerly CHEM 473 and CHEM 474 is listed as follows):

Chemistry 498K Medicinal Chemistry 3 credits

Instructor: Y.S. Tsantrizos
Prerequisite: Chem 324 or equivalent
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Topics of current interest in medicinal chemistry; antiviral and antitumor agents, peptidomimetics and mechanism based, enzyme inhibitors, antiinflamatory and antimicrobial agents. Topic will include chemical synthesis, studies on the mode of action of chemotherapeutic agents, drug design and molecular pharmacology.

Note: Students who have received credit for CHEM 473 or CHEM 474 may not take this course for credit.

Chemistry 477 Advanced Laboratory in Biochemistry 3 credits

Instructors: M.J. Kornblatt, J. Powlowski
Prerequisite: CHEM. 375; BIOL. 368
For: Programmes in biochemistry and biochemistry & molecular biology
Format: Tutorial and laboratory
Basis of Grading: Laboratory work, reports and final exam
Description: Theory and practice of techniques in enzymology and protein chemistry, including steady-state and stopped-flow enzyme kinetics, ligand binding, immunological techniques, computer modelling, identification of groups at the active site.

Note: Students who have received credit for CHEM. 479 may not take this course for credit.

Chemistry 478 Hormone Biochemistry 3 credits

Instructor: J. Fraser
Prerequisites: Chem. 271 and third-year standing (60 crs completed)
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: This course deals with an in-depth study of the vertebrate hormones and involves a study of the precise chemical structure and properties of each hormone, its biosynthesis and mode of secretion from the cell. The circulating form of the hormone is examined, as well as the nature of the hormone receptor. The cellular mechanism of action and the relationship of the hormone's action to the intact animal are investigated.

Chemistry 481 Bioinorganic Chemistry 3 credits

Instructor: A. English
Prerequisites: Chem. 241, 271
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Role of metals in biochemical systems. Essential trace elements, zinc enzymes, oxygen transport and storage, metalloproteins and biological electron transfer, structure-function relationships in heme enzymes, nitrogen fixation; model compounds for metalloproteins and metalloenzymes.

Chemistry 492 Chemical Spectroscopy 4 credits

Instructor: J. Capobianco
Prerequisites: Chem. 324 (or 321) and 328
For: Optional course
Format: Lectures and laboratory
Basis of Grading: Mid-term, final exams, laboratory work and reports
Description: Theory and application of EPR spectroscopy, rotational spectroscopy, rotation-vibrational spectroscopy, Raman spectroscopy. Lectures and laboratory.

Chemistry 493 Magnetic Resonance Spectroscopy 3 credits

Instructor: L.D. Colebrook
Prerequisite: Chem. 221 or equivalent
For: Optional course
Format: Lectures
Basis of Grading: TBA
Description: This course is designed to provide the background in magnetic resonance theory necessary to understand modern high-resolution NMR experiments and instrumentation. The basic theory in the introductory section also applies to electron spin resonance (ESR). Relaxation and through-bond and through-space interactions, and experiments to investigate them, are considered. Spin manipulations and behaviour in multiple-pulse, Fourier transform NMR techniques used for common spectral editing and two-dimensional experiments are discussed.

Note: Students who have received credit for Chem. 498L may not take this course for credit.

Chemistry 494 Mass Spectrometry 3 credits

Instructor: R.T. Rye
Prerequisite: Chem. 235 or Chem. 331
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams.
Description: Production and interpretation of mass spectra. Topics to be covered will include: ionization methods (electron impact, chemical ionization and fast-atom bombardment); interpretation of mass spectra; introduction to quantitative analysis by mass spectrometry.

Note: Students who have received credit for Chem. 498T may not take this course for credit.

Chemistry 498 Advanced Topics in Chemistry 3 credits

Courses under this number and heading are scheduled as the demand and opportunity arises. There is no guarantee that a particular topic will be scheduled in any particular year. Students are advised to consult the schedule.

Some topics that have been offered in the past few years are noted below:

- Membrane Biochemistry
- Advanced Bio-organic Chemistry
- Protein Structure Engineering
- Analytical Separations
- Mössbauer Spectroscopy and Magnetic Properties of Materials
- Molecular Spectroscopy
- Photochemistry
- Electron Transfer in Chemistry and Biology
- Crystal Chemistry
- Mass Spectroscopy
- Bio-analytical Chemistry
- Catalytic Processes in the Chemical Industry
- Homogeneous Catalysis
- Computational Chemistry
- Neurochemistry
- Organometallic Chemistry
- Thermodynamics of Irreversible Processes

Chemistry 499 Advanced Topics in Chemistry 6 credits

See "Note" for Chem. 498